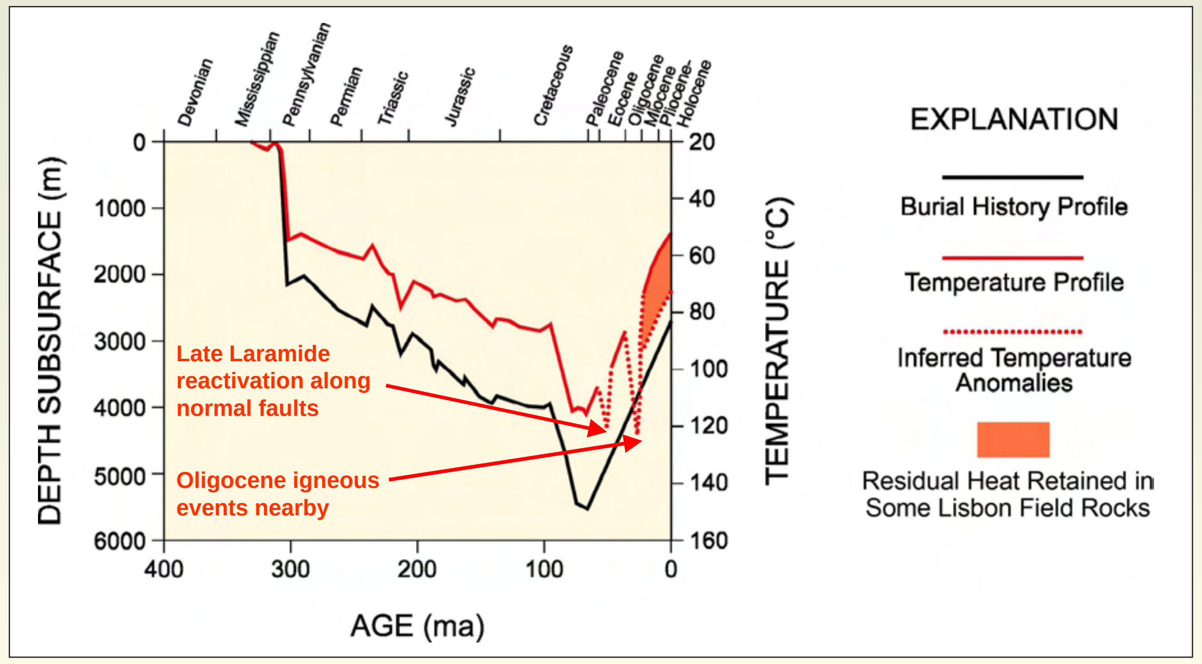
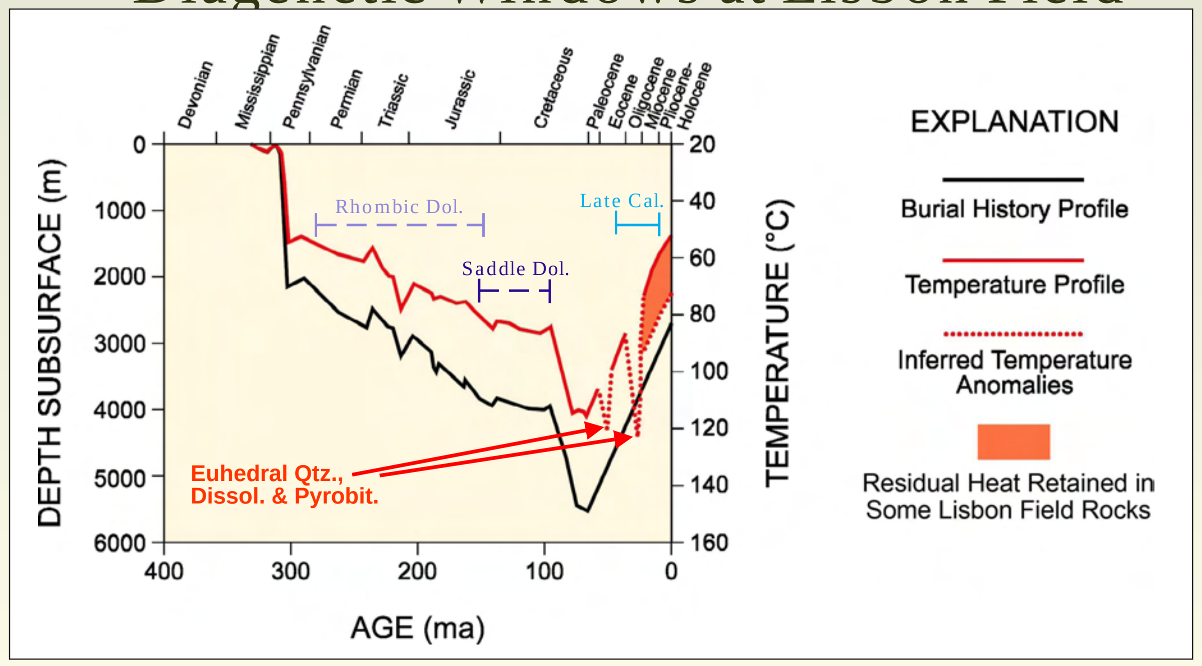
Burial History and Temperature Profile with



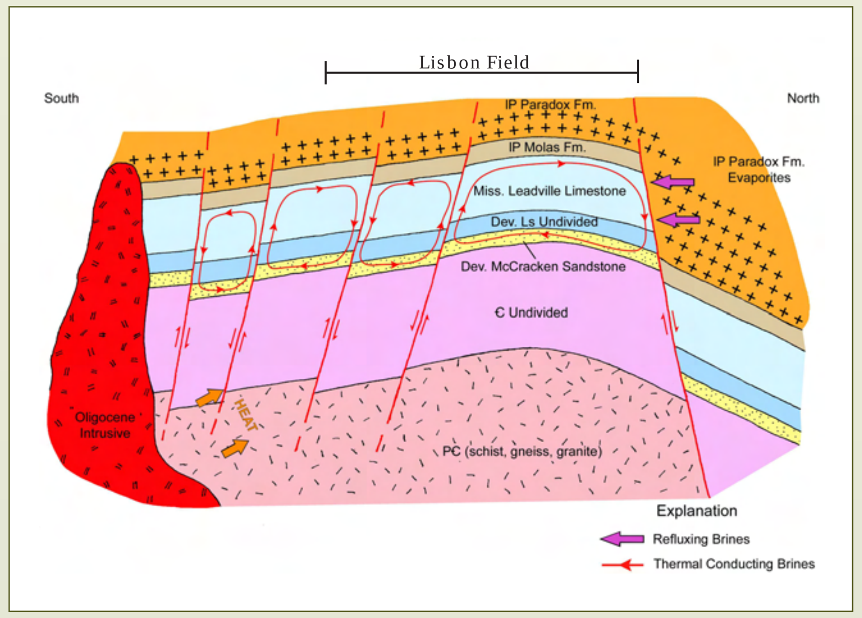
In addition to the calculated temperature profile related to the Leadville Limestone burial history at Lisbon, we have inferred anomalous temperature spikes for: (1) Late Laramide reactivation along normal faults that extend to basement; and (2) Oligocene igneous events such as the emplacement of the nearby La Sal igneous complex.

Burial History and Temperature Profile with Inferred Diagenetic Windows at Lisbon Field

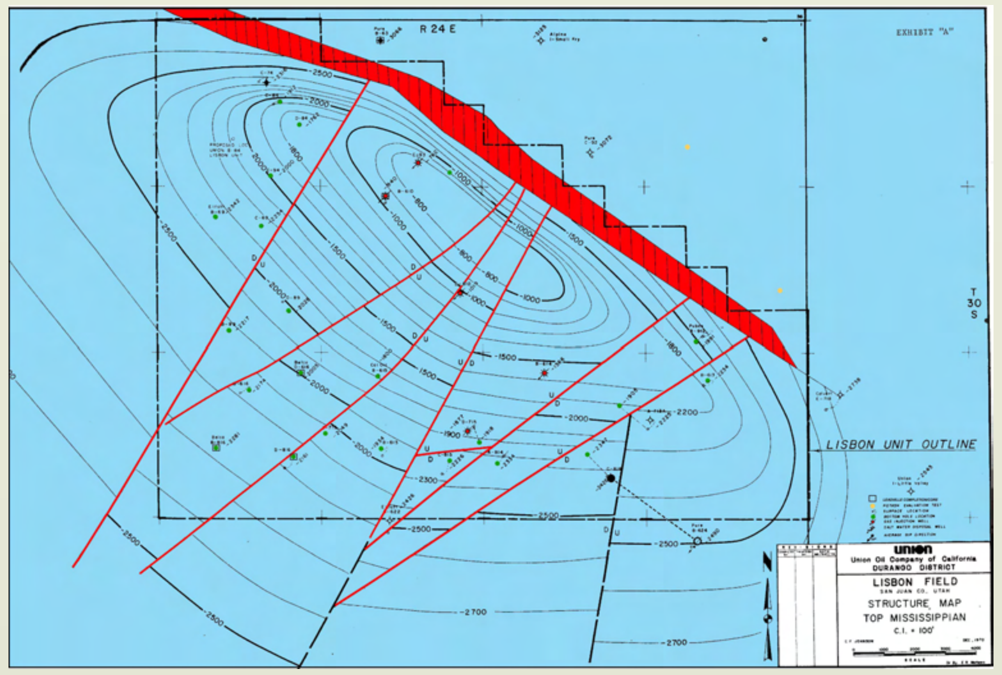


Suggested windows for important diagenetic phases in the reservoir history of the Leadville Limestone at Lisbon field are shown for: (1) the formation of rhombic dolomites and major intercrystalline ("sucrosic") porosity; (2) saddle dolomite clear rims and cements; (3) euhedral quartz, dissolution of limestone and dolomite matrix, and pyrobitumen formation; and (4) late calcite cements (with live oil inclusions).

Convection Cells & Possible Heat Sources for Late Dolomitization & Dissolution



A highly diagrammatic South to North cross section for the greater Lisbon field area shows the concept of possible convection cells as the circulation model for ascending warm fluids responsible for saddle dolomites, high-temperature quartz, pyrobitumen formation, aggressive dissolution of limestones and dolomites, and sulfide mineralization. The basal aquifer for these inferred fault-controlled cells could be the Devonian McCracken Sandstone. This sandstone is locally porous enough to produce oil at Lisbon field. Sources of heat may have been from the basement



Some of the mapped faults cutting Lisbon field may be involved with thermal convection cells for circulating fluids during late burial diagenesis (see arrows). Some wells near faults appear to have better reservoir quality, produce greater volumes of oil, and have higher residual bottom hole temperatures than wells away from these faults.

Conclusions

- The Leadville Limestone in the northern Paradox Basin was deposited in open-marine shelf settings under variable energy conditions. Depositional facies determined from cores range from crinoidal shoals, peloid / ooid shoals and small Waulsortian-type mounds.
- Leadville porosity within Lisbon field does not follow depositional facies and does not correlate across the field in association with unconformities or mappable log zonal correlations.
- Neither early dolomitization nor karst-related processes have created significant reservoir porosity and permeability at Lisbon field.
- Reservoir porosity and permeability was developed by:
  - Post-stylolitization and post-fracture replacement dolomitization which created zoned rhombic and saddle dolomites.
  - Major dissolution (forming vugs and microporosity) and brecciation of limestones and early dolomites along faults and fractures.
- Late cements and coatings around dissolution pores and fractures include:
  - Saddle dolomites
  - Anhydrite lathes
  - Doubly terminated quartz
  - Pyrobitumen
  - Sulfide minerals
  - Calcite spar
- Stable oxygen isotope analyses of the zoned replacement dolomites indicate that temperatures of precipitation ranged from ~62-90° C. Saddle dolomite cements were precipitated at temperatures >90° C.
- Fluid inclusions within dolomites have re-equilibrated since trapping. Single phase aqueous inclusions in fine-grained dolomites and in cores of rhombic and saddle dolomites suggest earliest formation at relatively low temperatures (<50° C). Coarser rhombic and saddle dolomite rims precipitated at higher temperatures.
- Homogenization temperatures of primary inclusions within doubly terminated quartz crystals are in the 120-130° C range. There are also gas-rich inclusions within the quartz.
- Quartz- and late calcite spar-hosted inclusions display low ice-melting temperatures which suggest that complex Ca-Mg brines associated with evaporites were responsible for precipitation of these minerals.
- Pyrobitumen formation and sulfide mineral precipitation may be related to the high temperatures documented by primary inclusions in quartz and the evaporite brines responsible for quartz precipitation.
- Oil trapped in primary inclusions within portions of some saddle dolomites and as secondary inclusions within late calcite spar indicate a temperature of at least 70° C during oil emplacement and saddle dolomite formation.
- Oil emplaced within healed fractures in late calcite spar cements display lower homogenization temperatures of ~40° C, indicative of late unroofing and / or uplift.
- Burial history and temperature profiles for the Leadville at Lisbon field provide some guidance for when important diagenetic and porosity-forming events occurred. Porous replacement dolomites probably formed during the early and middle portions of the burial history at Lisbon field. Inferred elevated temperature spikes during maximum burial, late Laramide faulting / uplift and Oligocene igneous activity may be a response from the high temperatures responsible for quartz precipitation, sulfide mineralization, pyrobitumen formation, late dissolution of carbonates and late saddle dolomite cements.
- We propose a model with convection cells bounded by basement-rooted faults to transfer heat and fluids from possible crystalline basement, Pennsylvanian evaporites and Oligocene igneous complexes.

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